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Criteria for Determination of MC&A System Effectiveness

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ABSTRACT

The Nevada Test Site (NTS) is a test bed for implementation of the Safeguards First Principles Initiative (SFPI), a risk-based approach to Material Control & Accountability (MC&A) requirements. The Comprehensive Assessment of Safeguards Strategies (COMPASS) model is used to determine the effectiveness of safeguards systems under SFPI. Under this model, MC&A is divided into nine primary elements. Each element is divided into sub-elements. Then, each sub-element is assigned two values, effectiveness and contribution, that are used to calculate the rating. Effectiveness is a measure of sub-element implementation and how well it meets requirements. Contribution is a relative measure of the importance, and functions as a weighting factor. The COMPASS model provides the methodology for calculation of element and sub-element, but not the actual criteria. Each site must develop its own criteria. For the rating to be meaningful, the effectiveness criteria must be objective and based on explicit, measurable criteria. Contribution (weights) must reflect the importance within the MC&A program. This paper details the NTS approach to system effectiveness and contribution values, and will cover the following: the basis for the ratings, an explanation of the contribution weights, and the objective, performance-based effectiveness criteria. Finally, the evaluation process will be described.

INTRODUCTION

Safeguards First Principles Initiative (SFPI) is a risk based approach to Material Control & Accountability (MC&A) requirements. The general idea is to use only those requirements (from the U.S. Department of Energy [DOE] Order/Manual) that make sense for the site, to modify or "delete" other requirements, and to incorporate the requirements into the MC&A Plan. Approval of the plan by Site Office means that the MC&A Plan effectively becomes the DOE Order for that site.

The Nevada Test Site (NTS) was selected as a test bed for SFPI implementation. The MC&A Plan was revised to reflect all elements and requirements that will be implemented at NTS to include all requirements that differ from the current DOE Order. Note that for initial test bed implementation, a deviation was put in place to cover all requirements that changed under SFPI. As a test bed, it will be important to accurately assess the requirements that are implemented and the effectiveness of that implementation. This paper discusses the NTS approach to effectiveness determination.

EFFECTIVENESS MODEL

The Comprehensive Analysis of Safeguards Strategies (COMPASS) model was developed to evaluate MC&A program element effectiveness. Nine MC&A requirements were defined during the initial development of SFPI. These became the program elements for the COMPASS model.

Each element is broken down further into sub-elements. These were determined at the site level by MC&A staff in conjunction with the site office MC&A Manager. The elements and sub-elements are shown in Table 1.

Table 1: Program Elements and Sub-Elements

Element	Sub-Element	Element	Sub-Element
MC&A Plan	Integrate requirements into other documents	**Surveillance**	Locks/Alarms
	Review Frequency		DACs
	Change Control		Metal detectors
	Independent Assessments		Pedestrian SNM Monitors
	MBA Data Sheets		Vehicle SNM Monitors
	Training		Two-Person
Graded Safeguards	Determine Category		Key/Combination Control
	Rollup Evaluation		TIDs
	Safeguards Termination		Access Lists
Accounting Systems	Data Accuracy		Waste Monitoring
	Inventory		Material Location
	Equipment/Data Access	**Inventories**	Frequency
	Accounting System Structure		Physical Inventory Location Integrity
	Tracking Cat I/II		Item Count Inventory
	Tracking Cat III/IV		Reconciliation
	Records/reports	**S/R Differences**	Anomaly Resolution
Measurements	Method Qualification		Accounting System Updates
	Standard Qualification	**Assessments/ Performance Testing**	MC&A Assessments
	Measurement Control		Performance Tests
	Measurement Equipment/Data		Schedule/Frequency
Containment	Structure		CAPs
	MBA Custodians	CAP – Corrective Action Plan DAC – Daily Administrative Check MBA – Material Balance Area SNM – Special Nuclear Material TID – Tamper Indicating Device	
	Transfers		
	MBA Data Sheets		
	Inventory		

Two values are assigned to each sub-element, effectiveness and contribution, based on the element implementation and relative importance. The effectiveness should be based on requirement implementation and performance. The contribution functions as a weight factor for each effectiveness. The product of the two values is the rating for that sub-element. The element ratings are weighted averages of the sub-elements. The overall system effectiveness rating is a function of the individual element ratings. The overall rating specifies the approval level required for the MC&A Plan. The calculation of sub-element, element, and overall ratings is illustrated below.

For each sub-element: $Rating = (effectiveness) \times (contribution)$

For each element: $$Rating = \frac{\sum_{sub-elements} (effectiveness) \times (contribution)}{\sum_{sub-elements} (contribution)}$$

Overall: $$Rating = \frac{\sum_{elements} (element\ effectiveness) \times (average\ contribution)}{\sum_{elements} (average\ contribution)}$$

Table 2 gives an example of the model and calculations for system effectiveness.

Table 2: Model Example

Element	Sub-Element	Effective-ness	Contribution	Eff x Cont	Element Rating	Average Contribution	Overall Rating
X	X_1	8	4	32			
	X_2	9	3	27			
	X_3	6	2	12			
			9	71	7.88	3.0	23.64
Y	Y_1	8	4	32			
	Y_2	8	3	24			
			7	56	8.00	3.5	28.00

Totals	6.5	51.64
Overall Rating		7.94

EFFECTIVENESS RATINGS

The effectiveness ratings are objective criteria used to rate each sub-element in the model. The basis for the ratings is twofold. First, if the program is implementing the necessary requirements and there are no issues, then the rating should allow the U.S. Department of Energy, National Nuclear Security Administration (NNSA) site office MC&A Manager to approve the plan. Second, the ratings should allow the program to be "rewarded" for doing more than required. A rating of 8 was selected as the value meeting the basis above. This value indicates adequate implementation and performance; it means that the sub-element is doing what it is supposed to. The sub-elements are rated on this premise. The element ratings are composites of the sub-elements, and the overall rating is a composite of the element ratings. The Plan Approval Matrix, Table 3, is shown below. An overall rating of 8 (or greater) means that the MC&A Plan can be approved by the Nevada Site Office MC&A Manager. The rating values were developed for the 10-point scale required by the model. No rating may exceed 10.

Table 3: Plan Approval Matrix

Overall MC&A System Effectiveness	**Qualitative Rating**	**Approval Required**
8-10	High	Site office Security Director or MC&A Manager
5-7	Medium	Site Office Manager
1-4	Low	Chief Defense Nuclear Security

Defining adequate implementation and performance as 8 also allows the sub-element to be rewarded for exceeding requirements and superior performance. This can be illustrated by two examples: (1) the accounting system must accurately reflect identity and location for 99% of

items selected, so if testing and assessment indicates an accuracy rate greater than 99%, the sub-element should get credit for that; and (2) if one outside assessment is required and two are performed, then credit should be given for exceeding the requirement.

The goal of the ratings is to accurately assess the effectiveness of the program elements and implementation. To do this, the criteria used must be measurable and defensible. The results of assessments and performance testing are both. The basic rating will be based on results of DOE/NNSA assessments and performance requirements. The rating can be adjusted based on the results of non-DOE/NNSA assessments and results of the performance testing program. This adjustment may be either positive or negative. The ratings scale is given in Table 4. Each value is defined explicitly in terms of requirement implementation and performance, and is measured by the results. These criteria are applied to each sub-element during the review.

Table 4: Effectiveness Ratings

Rating	Criteria
10	Exceeds order requirements, no findings[1], total assessments[2] > required
9	Meets order requirements, no findings, total assessments > required
8	Meets order requirements, no findings
7	Meets order requirements, 1 open finding
6	Meets order requirements, 2 open findings or 1 repeat finding
5	Meets order requirements, more than 2 open findings or 1 repeat finding, or Does not meet order requirements, 1 open finding
4	Does not meet order requirements, 2 open findings or 1 repeat finding
3	Does not meet order requirements, more than 2 open findings
2	Does not meet order requirements, 2 or more repeat findings
1	Order requirement not implemented

[1]DOE/NNSA assessments only
[2]All assessments, DOE/NNSA and internal/external non-DOE/NNSA

Ratings will be further adjusted if the following conditions are met:

1. Internal/external non-DOE/NNSA assessments:
    a. 1-2 open findings, subtract one point.
    b. 3-4 open findings, subtract two points.
    c. >4 open findings, subtract three points.
2. Performance Tests:
    a. Performed > required, 0-1 failures, add one point.
    b. Performed = required, no change.
    c. Performed < required, subtract one point.
    d. >1 failure, subtract one point.
3. Rating impacting issues (DOE/NNSA), rating may be no higher than 5.
4. Closed findings do not affect ratings.

CONTRIBUTION FACTORS

The contribution factor is a weight and is indicative of the relative importance of the element. The ratings are primarily based on program element importance as defined in the MC&A Performance Testing procedure. The 0-4 scale was used because of the limited number of meaningful categories that could be developed.

Table 5: Contribution Factors

Rating	Contribution
4	Provides loss detection or accounts for material
3	Implements requirement
2	Ensures requirement implementation
1	Implements business practice
0	No contribution

REVIEW FREQUENCY

The model will be reviewed at least quarterly, and will incorporate assessment and performance testing results. The review will be performed by the MC&A Department Manager and all section managers (Compliance, Material Control, and Measurement Control) and is documented. A review worksheet was developed to aid this process, and is illustrated below. It includes all performance measures for each sub-element, and makes calculation of the rating straightforward.

Element	Sub-element	Current Rating	DOE/NNSA Findings	Int/Ext Findings	PTs Required	PTs Performed	PTs Failed	Requirements Exceeded	Plus	Minus	Total
X	X_1	8	1	0	2	2	1	0	0	1	7
	X_2	9	0	0	5	8	0	0	1	0	10

CONCLUSION

The NTS is a test bed for SFPI implementation. The key to demonstrating effective implementation is an objective methodology for assessment. The COMPASS model provides the framework for this assessment. The goal was to develop objective criteria that accurately reflect how well each sub-element of the MC&A program is implemented. The results of assessments and performance tests achieve this goal. The criteria defined above provide a straightforward and defensible approach to determining implementation effectiveness.

This is only the initial implementation. The model and criteria are flexible enough to account for changes in requirements and ways of doing business. As experience is gained with the methodology, the criteria may be revised to more accurately rate effectiveness. It is expected to be a continuing process.

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Introduction

- Nevada Test Site was a test bed for Safeguards First Principles Initiative (SFPI) Implementation
- SFPI: a risk-based approach to Material Control & Accountability (MC&A) requirements.
  - Site-defined requirements
  - May not include all requirements in current order/manual
- Deviation necessary for implementation

Methodology

- Need a methodology to assess the effectiveness of implementation
- Comprehensive Assessment of Safeguards Strategies (COMPASS) Model provides framework
- Nine program elements (from “above”)
- Sub-elements site defined by MC&A Plan

Model Mechanics

- Each sub-element gets two values:
  - Effectiveness (measure of implementation)
  - Contribution (relative importance)
- Contribution functions as “weight”
- For each sub-element:

$$Rating = (effectiveness) \times (contribution)$$

Model Mechanics

- For each element:

$$Rating = \frac{\sum_{sub-elements}(effectiveness) \times (contribution)}{\sum_{sub-elements}(contribution)}$$

- Overall:

$$Rating = \frac{\sum_{elements}(element\ effectiveness) \times (average\ contribution)}{\sum_{elements}(average\ contribution)}$$

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Model Mechanics Example

Element	Sub-Element	Effective-ness	Contribution	Eff x Cont	Element Rating	Average Contribution	Overall Rating
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			7	56	8.00	3.5	28.00
						Totals	6.5	51.64
						Overall Rating		7.94

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Effectiveness Ratings

- Basis
  - Requirements met ⇒ DOE/NNSA MC&A Manager approval
    - Approval Matrix

Overall MC&A System Effectiveness	Qualitative Rating	Approval Required
8-10	High	Site office Security Director or MC&A Manager
5-7	Medium	Site Office Manager
1-4	Low	Chief Defense Nuclear Security

  - Select 8 as meaning requirements being met, no issues
  - Reward program for exceeding requirements

Effectiveness Ratings

- Need criteria to assess effectiveness
- Must be measurable
- Must be defensible
- Criteria:
  - Results of DOE/NNSA Assessments
  - Results of non-DOE/NNSA Assessments
  - Results of Performance Tests
  - Adherence to Assessment/Performance Testing Schedule

Criteria

Rating	Criteria
10	Exceeds order requirements, no findings[1], total assessments[2] > required
9	Meets order requirements, no findings, total assessments > required
8	Meets order requirements, no findings
7	Meets order requirements, 1 open finding
6	Meets order requirements, 2 open findings or 1 repeat finding
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1	Order requirement not implemented

[1]DOE/NNSA assessments only.

[2]All assessments, DOE/NNSA and internal/external non-DOE/NNSA.

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Adjustment Criteria

- Internal/external non-DOE/NNSA assessments:
  - 1-2 open findings, subtract one point.
  - 3-4 open findings, subtract two points.
  - >4 open findings, subtract three points.
- Performance Tests:
  - Performed > required, 0-1 failures, add one point.
  - Performed = required, no change.
  - Performed < required, subtract one point.
  - >1 failure, subtract one point.
- Rating impacting issues (DOE/NNSA), rating may be no higher than 5.
- Closed findings do not affect ratings.

Contribution Factors

- Contribution = “weight”
- Defined in Performance Testing procedure
- Values:
  - 4 Provides loss detection or accounts for material
  - 3 Implements requirement
  - 2 Ensures requirement implementation
  - 1 Implements business practice
  - 0 No contribution

Review

- Quarterly
- Department Manager and Section Managers
- Documented
- Copy to NNSA MC&A Manager

Review Worksheet

Element	Sub-element	Current Rating	DOE/NNSA Findings	Int/Ext Findings	PTs Required	PTs Performed	PTs Failed	Reqs Exceeded	Plus	Minus	Total
X	X_1	8	1	0	2	2	1	0	0	1	7
	X_2	9	0	0	5	8	0	0	1	0	10

Conclusion

- Need to determine SFPI effectiveness
- Methodology: COMPASS Model
- Criteria: Measurable and Defensible
- Based on
  - Assessment Results
  - Performance Testing Results
- Developed criteria give objective, performance-based program rating.